Purpose: Feasibility study of a prototype developed for breathing synchronized irradiation.
Methods and Materials: Adaptations to a commercially available image-guidance technique (NovalisBody/ExacTrac4.0, BrainLAB) have been implemented allowing gating. A simple phantom simulating a breathing pattern of 16 cycles/min and covering 4 cm has been introduced to assess the system's performance to: (a) Trigger the linac at the right moment (using a 3mm metal hidden target (HTT) mounted to the phantom). (b) Assess the delivered dose in non-gated and gated mode (using an ionization chamber (IC) mounted to the phantom). (c) Evaluate the interplay between organ and leaf motion in IMRT (using radiographic film mounted to the phantom). The effect of interplay has been evaluated by importing measured fluence maps, generated by the linac in non-gated and gated mode, into the treatment planning system (TPS) and re-calculate the resulting dose distribution.
Results: No measurable delay in the triggering of the linac has been observed with the HTT. The IC measurements showed an improvement in dose absorption from 44% (non-gated) to 98% (gated) for small field irradiation (3x3 cm^2) of a moving target. Importing measured fluence maps actually delivered by the linac into the TPS yielded highly disturbed dose distributions with the non-gated delivery, whereas the gated delivery showed good agreement with the original theoretical dose distribution. These findings have been confirmed by the dose-volume histograms.
Conclusions: First tests with the prototype for breathing synchronized irradiation showed promising results. The use of measured fluence fields, delivered by the linac in non-gated and gated mode, as imported fluence maps for the TPS revealed the impact of interplay between leaf and organ motion and the possibility of gating to resolve this issue. The latter should be outweighed against increased treatment time.
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